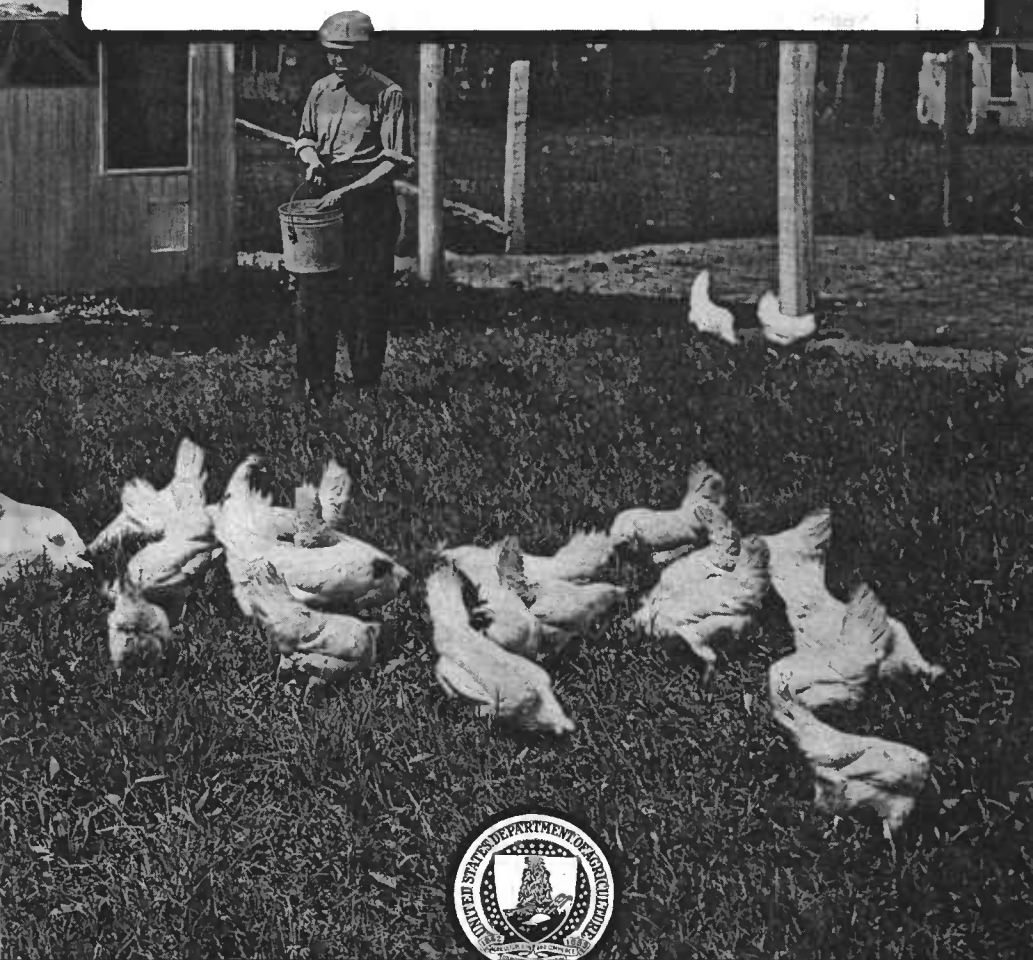


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Farmers' Bulletin 1067
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FEEDING HENS FOR EGG PRODUCTION



GOOD EGG production and profitable returns from laying hens are largely the result of properly balanced rations composed of wholesome feeds.

A balanced ration is a combination of feeds which furnish just the necessary amount of nutrients to produce the highest and most economical egg yields.

In the experiments on which this bulletin is based general-purpose pullets produced a dozen eggs from 6.7 pounds of feed, and Leghorn pullets from 4.8 pounds of feed. Old hens required a much larger amount of feed than pullets in producing a dozen eggs.

To get the most profitable results, feed simple mixtures composed of home-grown grains and their by-products, supplemented with meat or fish scrap or milk, such as a scratch mixture of 2 parts cracked corn and 1 part oats, and a mash of 3 parts corn meal and 1 part meat scrap.

Raise all the green feed and as much grain as possible.

Contribution from the Bureau of Animal Industry

JOHN R. MOHLER, Chief

Washington, D. C.

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FEEDING HENS FOR EGG PRODUCTION.

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CONTENTS.

	Page.		Page.
Importance of proper feeding.....	3	Quantity of grain to feed.....	9
Use of grains and their by-products.....	3	Meat feeds make eggs.....	9
Balanced rations.....	4	Green feeds, grit, and oyster shells.....	11
Egg-laying rations.....	7	Grain consumed in producing a dozen eggs..	12
Methods of feeding.....	8		

IMPORTANCE OF PROPER FEEDING.

FEEDING is one of the most important factors in egg production. On poor rations hens will live and even keep in fair health; but well-balanced, palatable feeds are necessary to get good egg production. The additional cost of a good ration compared with a poor ration is repaid many times by the extra eggs obtained. As a rule the simplest feed mixtures composed of home-grown grains and their by-products, supplemented by sweet or sour milk or some animal feed rich in protein, such as meat scrap, will prove most profitable and will produce eggs at the lowest cost.

There is no one best ration for all conditions, but many of the grains can be fed interchangeably, depending on their availability and price. The rations described in this bulletin are recommended as the result of extensive feeding experiments conducted at the Government farm at Beltsville, Md.¹

USE OF GRAINS AND THEIR BY-PRODUCTS.

Corn, wheat, oats, and barley are the principal grains fed to poultry; kafir corn and buckwheat are used also, but are not so generally available and usually cost more. Corn and wheat are the two best grains and are about equal in value as poultry feeds, although wheat can be fed alone better than corn, which is inclined to be fattening. Oats and barley, on account of their hulls and higher fiber content, are not so good as corn or wheat. Rye is not well relished by fowls and is seldom fed. Wheat screenings or slightly damaged grains sometimes may be bought to advantage, their

¹ Details of this experimental feeding work are contained in Department of Agriculture Bulletin 561, entitled "Feed Cost of Egg Production."

value depending entirely upon their quality and condition, but as a rule only sound grains in good condition should be fed to poultry, and moldy grains should never be used. The locally grown grains which poultry will eat freely may generally be used to the best advantage. A scratch mixture, consisting of whole or cracked grains made of a combination of any two or more of those mentioned, can be fed to advantage. It is not advisable to feed continuously any single grain, especially corn, owing to its fattening properties already mentioned.

A mash made of ground grains, mill products, and meat scrap should be fed usually in addition to the scratch mixture. Corn meal, wheat bran, wheat middlings, and meat scrap form the basis of a good mash, while corn chop, corn-and-cob meal, ground oats, and low-grade flour also may be added or substituted to advantage. Just as good results can be obtained from a simple mash containing 3 or 4 ground grains and meat scrap as from a highly complicated mash containing 10 or 12 products.

A large number of commercial mixtures both of scratch grains and of ground grains are prepared for poultry feeds, but the value of any mixed commercial feed depends upon its composition and the quality of the grains used in its preparation. If a poultry raiser does not produce any grain and keeps a comparatively small number of fowls it is often better for him to buy commercial mixed feeds. The average farmer, however, should feed home-grown grains supplemented with mill feeds and meat scrap, and the large poultryman usually can mix his own feeds to best advantage. When 2 or 3 kinds of grain are raised, and ground or mill feeds are not readily available, good results can be obtained by feeding only the grains, provided they are supplemented with meat scrap or milk.

BALANCED RATIONS.

A balanced egg-laying ration is a combination of feeds which furnish just the necessary amount of nutrients (protein, nitrogen-free extract, and fat) to produce the highest and most economical egg yields. Protein is a nitrogenous nutrient which supplies material for body structure, while nitrogen-free extract consists of the starches and sugars, and supplies heat, energy, and fat. Feeds used primarily to supply protein are meat scraps, fish meal, cottonseed meal, and milk products. Feeds especially high in nitrogen-free extract are corn, wheat, oats, and their by-products.

THE NUTRITIVE RATIO.

A good egg-laying ration should include (1) a scratch mixture and (2) a mash composed of palatable feeds containing some animal-protein feed, considerable bulk, and supplying roughly about 1 part

of protein to $4\frac{1}{2}$ or 5 parts of nitrogen-free extract and fat, the fat being changed to terms of nitrogen-free extract, which is done by multiplying the fat by $2\frac{1}{4}$.

The proportion of protein to the total nitrogen-free extract is called the nutritive ratio.

Sufficient experiments have not been conducted in poultry feeding to determine the exact digestive values of the various grains for poultry, as has been done with cattle. Therefore it seems best to use the total composition of the feedstuffs in figuring this nutritive ratio rather than the digestible composition. In figuring the nutritive ratios in this bulletin the fiber content is not considered, as very little fiber is digested by poultry. The composition of the various poultry feeds is shown in Table 1.

Table 1.—Composition of poultry feedstuffs.

Feedstuff.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Corn.....	10.9	1.5	10.5	2.1	69.6	5.4
Kafir corn.....	12.8	2.1	9.1	2.6	69.8	3.6
Barley.....	10.9	2.4	12.4	2.7	69.8	1.8
Oats.....	11.0	3.0	11.8	9.5	59.7	5.0
Rye.....	11.6	1.9	10.6	1.7	72.5	1.7
Wheat.....	10.5	1.8	11.9	1.8	71.9	2.1
Rice.....	12.4	.4	7.4	.2	79.2	.4
Buckwheat.....	12.6	2.0	10.0	8.7	64.5	2.2
Sunflower seed (whole).....	8.6	2.6	15.3	29.9	21.4	21.2
Soy bean ^a	8.7	5.4	36.3	3.9	27.7	18.0
Cowpea ^a	11.9	3.4	23.5	3.8	55.7	1.7
Canada field pea ^a	15.0	2.4	23.7	7.9	50.2	.8
Peas ^a	13.4	2.4	22.4	6.4	52.6	3.0
Egyptian corn.....	12.6	1.9	9.9	1.9	69.7	3.9
Hempseed.....	8.0	2.0	10.0	14.0	45.0	21.0
Corn meal.....	15.0	1.4	9.2	1.9	68.7	3.8
Barley meal.....	11.9	2.6	10.5	6.5	66.3	2.2
Soy-bean meal ^a	10.2	5.0	35.9	3.4	28.0	17.5
Gluten meal ^a	8.6	.6	30.0	2.6	49.2	8.8
Gluten feed ^a	8.1	1.3	23.2	6.4	54.7	6.3
Brewers' grains ^a	8.0	3.4	24.1	13.0	44.8	6.7
Wheat bran.....	11.9	5.8	15.4	9.0	53.9	4.0
Wheat middlings.....	12.1	3.3	15.6	4.6	60.4	4.0
Wheat shorts.....	11.8	4.5	14.9	7.4	56.8	4.5
Wheat screenings.....	11.6	2.9	12.5	4.9	65.1	3.0
Cottonseed meal ^a	8.2	7.2	42.3	5.6	23.6	13.1
Linseed meal, old process ^a	9.2	5.7	32.9	8.9	35.4	7.7
Linseed meal, new process ^a	9.9	5.6	35.9	8.8	36.8	3.0
Peanut meal ^a	10.7	4.9	47.6	5.1	23.7	8.0
Skim milk, cream raised by separator ^b	90.6	.7	3.2	.....	5.2	.3
Buttermilk ^b	91.0	.7	3.0	.....	4.8	.5
Animal meal ^b	5.7	39.9	39.4	.....	.....	10.7
Meat scrap ^b	7.9	17.4	49.7	.....	.....	18.5
Meat meal ^b	6.3	.....	48.4	.....	.....	12.9
Fresh bone ^b	34.3	22.8	20.6	.....	1.9	20.5
Dried alfalfa hay.....	8.1	8.8	14.6	28.9	37.4	2.1
Mangel beets.....	90.9	1.1	1.4	.9	5.5	.2

^a Contains a high proportion of vegetable protein.

^b Contains a high proportion of animal protein.

HOW TO DETERMINE THE NUTRITIVE RATIO.

The following example, which is ration No. 1, given later in this bulletin, illustrates how a nutritive ratio is worked out. In this example the scratch mixture and the mash have been combined on the basis that the same number of pounds of scratch mixture (300) are fed as of mash. The mash as given in ration No. 1 totals only 24½ parts, so that in bringing this total up to 300 pounds we have to multiply each part by 12.25, which gives 196 pounds of corn meal, 80 pounds of meat scrap, etc., as shown in the example. Table 1 gives the number of pounds of the feed constituents (protein, nitrogen-free extract, and fat) in 100 pounds of each of the grains, so that in order to get the number of pounds of these constituents in 196 pounds of corn meal the composition given in the table is



FIG. 1.—A balanced ration. 1. Corn. 2. Wheat. 3. Oats. 4. Meat scrap. 5. Middlings. 6. Corn meal. 7. Bran. 8. Oyster shell. 9. Sprouted oats. 10. Grit. Nos. 1, 2, and 3 make up the scratch mixture; 4, 5, 6, and 7 mixed together make the mash.

divided by 100 to get the amount in 1 pound of corn meal and this is then multiplied by 196. A similar process is gone through in the case of the meat scrap, bran, and middlings. The constituents of the corn, wheat, and oats will be the same as in Table 1, since exactly 100 pounds of each of these feeds is used.

Table 2.—Ration No. 1 worked out to determine its nutritive ratio.

Feed.	Protein.	Nitrogen-free extract.	Fat.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
100 pounds corn.....	10.5	69.6	5.4
100 pounds wheat.....	11.9	71.9	2.1
100 pounds oats.....	11.8	59.7	5.0
196 pounds corn meal.....	18.0	134.6	7.5
80 pounds meat scrap.....	39.8	.....	14.8
12 pounds bran.....	1.8	6.5	.5
12 pounds middling.....	1.9	7.2	.5
Total.....	95.7	349.5	35.8

The fat, 35.8, is multiplied by $2\frac{1}{4}$, giving 80.5, which is added to the nitrogen-free extract, 349.5, making a total of 430.0. This, divided by the protein, 95.7, gives a nutritive ratio of 1 to 4.5 for this ration.

The protein content of a feed is one of the most important factors in determining its value. The ash content also should be taken into consideration, but most poultry rations contain a sufficient quantity of this material. Crude fiber is not readily digested by fowls, so that a large percentage of fiber is detrimental to a poultry feed. As shown in Table 1, meat, fish, and milk products furnish animal protein.

EGG-LAYING RATIONS.

All the following rations have been used with good results at the Government experimental farm at Beltsville, Md., but the reader, in making his selection, should choose the ration best adapted to local conditions and prices. Feeds not included in these rations may be added or substituted on the basis of their comparative analysis, provided the meat scrap or animal-protein feeds are not replaced by cottonseed meal or other high-vegetable-protein feeds. All changes in the feed should be made gradually, as sudden changes may decrease egg production materially.

Ration No. 1.

MASH.

16 pounds corn meal.
6 $\frac{1}{2}$ pounds meat scrap.
1 pound bran.
1 pound middlings.

SCRATCH MIXTURE.

1 pound cracked corn.
1 pound wheat.
1 pound oats.

Ration No. 2.

2 pounds corn meal or barley meal.
1 pound bran.
1 pound middlings.
1 pound meat or fish scrap.

2 pounds cracked corn.
1 pound oats.
1 pound wheat or barley.

Ration No. 3.

3 pounds corn meal.
1 pound meat scrap.

2 pounds cracked corn.
1 pound oats.

Ration No. 4.

9 pounds corn meal.
5 pounds middlings.
4 pounds bran.
2 pounds cottonseed or gluten meal.
2 pounds meat scrap.
2 per cent bone meal.

2 pounds cracked corn.
1 pound wheat.
1 pound oats.
1 pound barley.

Ration No. 5.

1 pound corn meal.
1 pound bran.
 $\frac{3}{4}$ pound meat scrap.
1 pound middlings.
1 pound ground oats.

2 pounds cracked corn.
1 pound wheat.
1 pound oats.
1 pound barley.

Ration No. 6.

3 pounds corn meal.
1 pound bran.
1 pound middlings.
 $\frac{1}{2}$ pound meat scrap.

2 pounds cracked corn.
1 pound wheat.
1 pound oats.

Feed with table scraps or cooked vegetables.

Ration No. 5 is especially adapted for yearlings or old hens of breeds inclined to get too fat, such as the Plymouth Rock, Orpington, and Wyandotte. As corn meal, fed with the meat scrap, is very fattening, those two feeds are cut down in the ration.

With ration No. 6 feed all table scraps available, or vegetables at the rate of 5 pounds daily to 30 hens.

Five per cent of bone meal may be used in any of these mashes and the quantity of meat scrap reduced accordingly, or 2 per cent of bone meal may be added without changing the mashes.

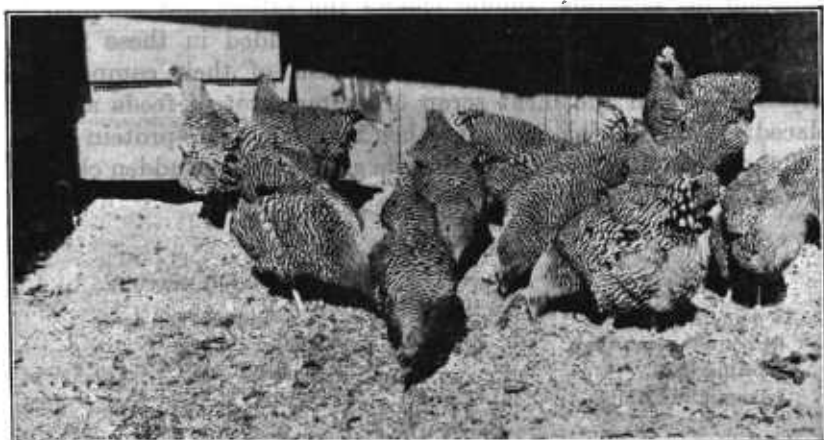


FIG. 2.—Making hens scratch in the litter for their grain. The exercise helps to keep them in good condition. In addition to the scratch grains a dry mash is kept in the hopper on the wall.

METHODS OF FEEDING.

The scratch mixture should be fed twice daily, preferably in litter from 3 to 5 inches deep on the floor of the henhouse. Feed about one-third of the mixture in the morning and two-thirds in the afternoon. In the morning give only what the fowls will eat up within half an hour and at night enough fully to satisfy them. Feed a mash either as a dry or moist feed in addition to the scratch grains. The dry mash is the more common method; it should be kept in a hopper before the fowls constantly. A moist (not sloppy) mash gives very good results when used by a careful feeder. It should be fed only once a day, preferably in the morning or at noon, and only as much should be fed as the fowls will clean up in from 15 to 30 minutes. A moist mash is very useful to use up table scraps and cooked vege-

tables and is greatly improved if mixed with milk. The quantity of meat scrap used in the mash can be reduced in proportion to the garbage and milk used. A light feed of moist mash sometimes may be fed to advantage to supplement the dry mash to pullets in the fall, if they do not eat the dry mash freely.

If hens show a tendency to become too fat, make them work longer for their feed by feeding the scratch grains in a deep litter; feed less scratch grain and reduce the quantity of meat scrap in the mash. It is sometimes necessary to close or hang up the dry-mash hopper until noon to make the hens work harder for their feed. Feed the same rations or combinations of feeds throughout the year and do not try to force the molt prematurely by special methods of feeding or by abnormal rations.

QUANTITY OF GRAIN TO FEED.

The feeder must use his own judgment in deciding how much grain to give the hens, as the amount of feed which they will eat varies with different pens and at different seasons of the year. They will eat more feed in the spring while laying heavily than in the summer and fall when laying fewer eggs. A fair general estimate is to feed about 1 quart of scratch grains and an equal weight of mash (about $1\frac{1}{2}$ quarts) daily to 13 hens of the general-purpose breeds, such as the Plymouth Rocks, Rhode Island Reds, or Wyandottes, or to 16 hens of the smaller or egg breeds. This would be about $7\frac{1}{2}$ pounds each of scratch grains and of mash daily to 100 Leghorns and about $9\frac{1}{2}$ pounds of each to 100 general-purpose fowls. If hens have free range or large yards containing green feed a general-purpose hen will eat about 75 pounds of feed in a year and a Leghorn will eat about 55 pounds, in addition to the green stuff consumed.

MEAT FEEDS MAKE EGGS.

Meat scrap or some other animal feed high in protein is the one essential constituent of the mash which can not well be omitted. In our experiments a pen of pullets, on free range, which did not get meat scrap or any other animal-protein feed, laid only 90 eggs each in a year, compared with yields of from 125 to 150 eggs from pens fed rations containing meat scrap. The eggs from the pen where no meat scrap was fed cost 2.2 cents more a dozen for feed than when the meat scrap was included in the ration. Fish meal or fish scrap can be used to replace the meat scrap and compares favorably with a good grade of meat scrap containing the same per cent of protein. Skim milk or buttermilk, either sweet or sour, is excellent for replacing part or all of the meat scrap. The milk may be used in mixing the mash if a moist mash is fed, or it can be kept before the fowls as a

drink. If clabbered and fed thick or like cheese, hens will eat enough of it to replace all the meat scrap needed. A little bone meal makes an excellent addition to the mash or it can be used to replace part of the meat scrap. Green-cut bone, if fresh and sweet, will also take the place of meat scrap if fed at the rate of one-third to one-half ounce daily per hen. If too much is fed it will give the fowls diarrhea or looseness of bowels.

On general farms during the growing months, the fowls pick up many bugs and worms which furnish an excellent source of animal-protein feed, and therefore they do not need so much meat scrap as hens which do not have a good range, but the bugs do not furnish

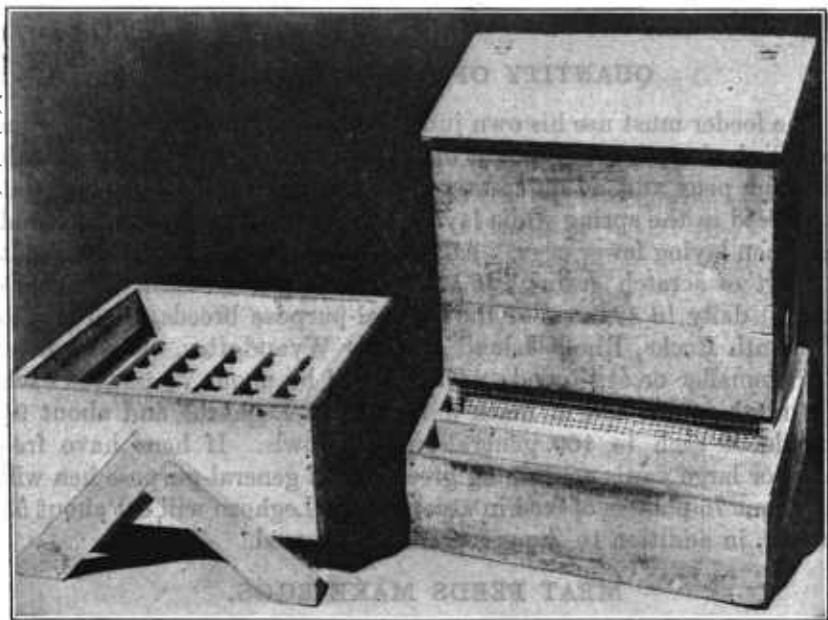


FIG. 3.—Two styles of homemade dry-mash hoppers. The box on the left is very simple and does not waste any feed.

meat feed enough to give a good egg yield. The use of table scraps and cooked vegetables also helps to reduce the necessary meat feed from one-third to one-half, depending on the quantity of meat products in the scraps. The scraps are fed to best advantage if ground up, mixed with the mash, and fed moist.

High-vegetable-protein feeds do not entirely replace meat or animal protein feeds to advantage, but in sections where they are produced may be used to replace one-fourth to one-half the meat scrap. Of the high-vegetable-protein feeds cottonseed meal has given us the best results, followed by peanut meal, soy-bean meal, and velvet-bean meal, named in the order of their values. Not more than one-tenth

of the mash should be composed of cottonseed meal, as the use of a larger proportion of cottonseed meal cuts down the egg yield materially and may affect the quality of the eggs, producing spots and blotches on the yolks which make them look bad. Other high-vegetable-protein feeds which can be used with success for poultry are gluten and linseed meal.

GREEN FEEDS, GRIT, AND OYSTER SHELLS.

Green feeds should be supplied to hens confined in small yards and also to all hens during the winter, when no green feed is available in the yards. Free range or large yards kept in grass will furnish ideal

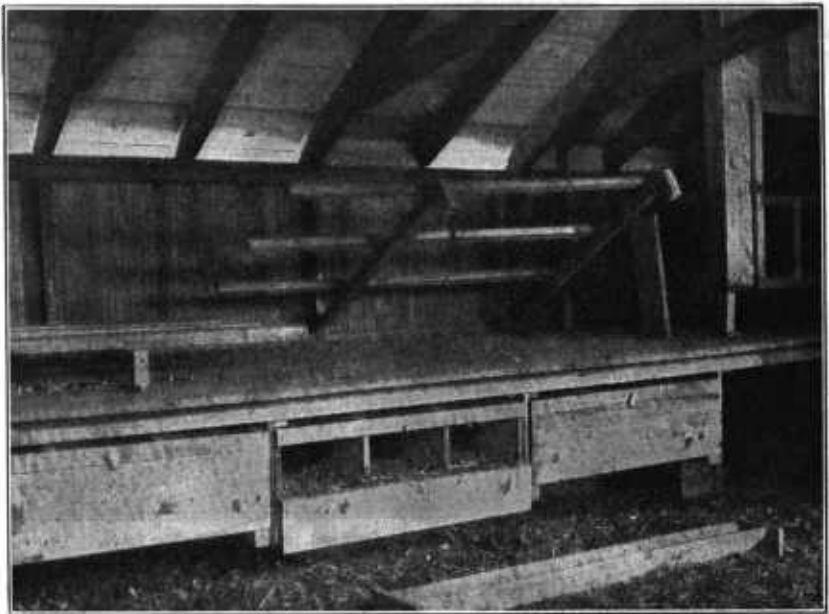


FIG. 4.—Interior of pen. Note feed trough for wet mash; also litter on floor where scratch grains are fed.

conditions for green feed, and where smaller yards have to be used they should be divided into 2 parts and used alternately, planting the vacant section 2 or 3 times yearly with a quick-growing green crop, such as rape, oats, wheat, rye, or barley. This method furnishes green feed and also helps to keep the yards sweet and clean, which is a very important consideration.

Good kinds of green feeds are sprouted oats, alfalfa meal, chopped alfalfa and clover hay, cabbages, and mangel beets. In ordinary cellars cabbages do not keep so well as mangel beets, so they should be used up first. Cabbages may be hung up in the poultry house; the beets are usually split and stuck on a nail on the side wall of the pen about a foot above the floor. Vegetables which have been frozen can

be thawed out and fed to fowls, but do not keep well after thawing. Clover and alfalfa may be fed as hay cut into one-quarter or one-half inch lengths, or they may be bought in the form of meal.

Oats for sprouting are soaked overnight in warm water and then spread out from one-half to one inch thick on trays having perforated bottoms and put into an oat sprouter. Water the oats thoroughly and turn the trays around once daily to promote even sprouting. Artificial heat should be supplied in cool weather by the use of a kerosene lamp or by some other means. Use a good grade of oats and allow a square inch of sprouted-oat surface per hen daily, feeding these sprouted oats on the floor of the poultry house or in the yard. Feed

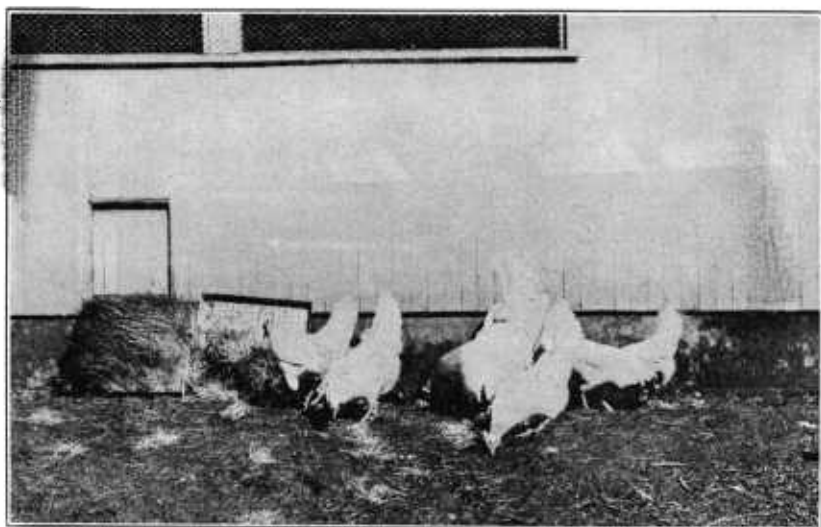


FIG. 5.—Eating sprouted oats as a green feed. Oats are sprouted in shallow trays.

at any time after the sprouts are well started, which usually takes from 5 to 7 days. Keep the sprouter clean and spray it occasionally with disinfectant to prevent the growth of mold spores.

Keep oyster shells and grit before the hens all the time. These substances are an inexpensive but quite necessary part of the ration. Hens will eat about 2 pounds of oyster shell and about 1 pound of grit each in a year.

GRAIN CONSUMED IN PRODUCING A DOZEN EGGS.

The feed cost of producing a dozen eggs depends upon the quantity and price of the grain consumed. If hens have free range on general farms they pick up considerable waste grains and other feed and are fed largely on grains produced on the farm, thus materially lowering the feed cost of the eggs. The prices of grains vary greatly in different sections and in different years, so that only the grain consumed in

producing a dozen eggs, not the cost, is included in this bulletin. The grain consumed per dozen eggs will depend very materially upon how successfully the hens are fed and managed, but the following table gives the average results of our experiments, including several different pens, in which the general-purpose fowls produced an average egg yield of 130.5 eggs as pullets and 88.1 as yearlings, while the Leghorns produced an average of 138.7 eggs as pullets and 124.9 eggs as yearlings:

Table 3.—Monthly record of total feed consumed per dozen eggs and egg yield per hen.

Month.	General-purpose pullets.		General-purpose yearlings.		Leghorn pullets.		Leghorn yearlings.	
	Feed per dozen eggs.	Eggs per hen.	Feed per dozen eggs.	Eggs per hen.	Feed per dozen eggs.	Eggs per hen.	Feed per dozen eggs.	Eggs per hen.
	<i>Pounds.</i>	<i>Number.</i>	<i>Pounds.</i>	<i>Number.</i>	<i>Pounds.</i>	<i>Number.</i>	<i>Pounds.</i>	<i>Number.</i>
November.....	10.9	8.1	34.6	2.4	.....	.....	.....	.....
December.....	7.4	11.2	32.9	2.6	5.3	9.1	20.3	3.0
January.....	10.9	9.9	32.7	2.5	6.6	10.0	10.0	7.0
February.....	5.5	10.8	12.6	6.1	5.4	12.1	5.8	10.3
March.....	5.8	16.4	8.5	9.3	4.7	16.0	5.1	14.2
April.....	4.6	16.5	5.7	13.1	3.3	18.3	3.6	17.7
May.....	4.4	13.9	5.3	10.5	3.0	19.0	3.3	19.4
June.....	4.7	12.0	6.1	10.4	3.2	14.8	3.4	16.3
July.....	6.3	9.9	7.5	8.6	4.9	10.4	3.9	14.8
August.....	6.9	9.3	7.6	11.0	4.8	10.6	5.3	11.5
September.....	9.2	7.5	10.0	6.7	8.6	8.0	7.1	7.4
October.....	14.1	5.0	21.0	4.9	10.9	5.2	30.8	2.9
November.....	.....	.....	.....	.....	18.4	5.2	18.6	.4
Average or total..	6.7	130.5	9.6	88.1	4.8	138.7	5.5	124.9

The general-purpose pullets ate in a year an average of 6.7 pounds of feed per 1 dozen eggs produced and the yearlings ate 9.6 pounds. The Leghorn pullets ate 4.8 pounds and the yearlings 5.5 pounds. The general-purpose pullets ate 1.9 pounds more feed in producing a dozen eggs than the Leghorn pullets, and the difference increases very rapidly with the age of the stock, the general-purpose yearlings consuming 4.1 pounds more feed per dozen eggs than the Leghorn yearlings; therefore the Leghorns produced eggs more cheaply than the general-purpose breeds. The value of the general-purpose breeds for market or for hatching and breeding makes them usually the most desirable breeds for the general farmer and the backyard-poultry raiser, while the Leghorns are especially adapted for commercial egg farms.

USE home-grown grains and their by-products, supplemented with meat and fish scrap or milk.

Mix these feeds to make a properly balanced ration.

Feed a scratch mixture of whole or cracked grains twice daily.

Feed a mash, either dry or wet, made of ground grains and meat scrap.

Supply more than one kind of grain.

Make the hens exercise for their feed.

Give a light feed of grain in the morning, only supplying what the hens will clean up in a half hour. Always give a full feed in the afternoon, especially in cold weather.

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